Advanced Science and Technology Letters
Vol.63 (NGCIT 2014), pp.214-218
http://dx.doi.org/10.14257/astl.2014.63.47

Decision support system for multiple water resource blending and water treatment plant

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Abstract. This study developed the decision support system in the water treatment system to support the operator to make informed decisions about the best course of action using multiple water resources. This system consists of process operation and process diagnosis parts to calculate historical and real time data and to optimize water blending ratios. With the decision support system, the operator can organize calculated and analyzed data and expect long term operational and analytical results to apply for economic, social and environmental effects in the future.

Keywords: DSS, water blending, water treatment plant, multiple waters

1 Introduction

While water demands increase in the world, water treatment systems confront complexity and difficulty for controlling or monitoring the whole treatment system. The adequate method to conquer the problems is to develop the suitable decision support system (DSS) in water treatment system. DSS often provides reliable and cost effective in water treatment system by automatic decision supporting. Information technology has rapidly developed and has been applied in many scientific fields. DSS in water treatment helped a user in choosing a consistent, near optimum solution for a particular problem in a reduced time frame (Poch et al. 2004). In the research, the water treatment system consists of multi-water blending, coagulation, sedimentation, filtration, ozone, and activated carbon. Adoption of DSS in WTP could enhance the performances of each unit process, producing much safer and stable quality and quantity of water, as well as managing an economical system for cost and energy savings. This research focused on developing the decision support system for use of multiple water resources and control of water treatment systems in order to satisfy both quality and quantity demand from consumers.

ISSN: 2287-1233 ASTL

2 Method

The basic structure of DSS can be divided into two major parts: process operation and process diagnosis. Process operation supports water blending and process algorism. Process diagnosis plays a vital role on diagnosing and solving problems for efficient water production and error management. Figure 1 displays a data flow diagram for process operation system within the WPT for surface water and underground water. Figure 2 explains a data flow diagram for process diagnosis system in WPT.

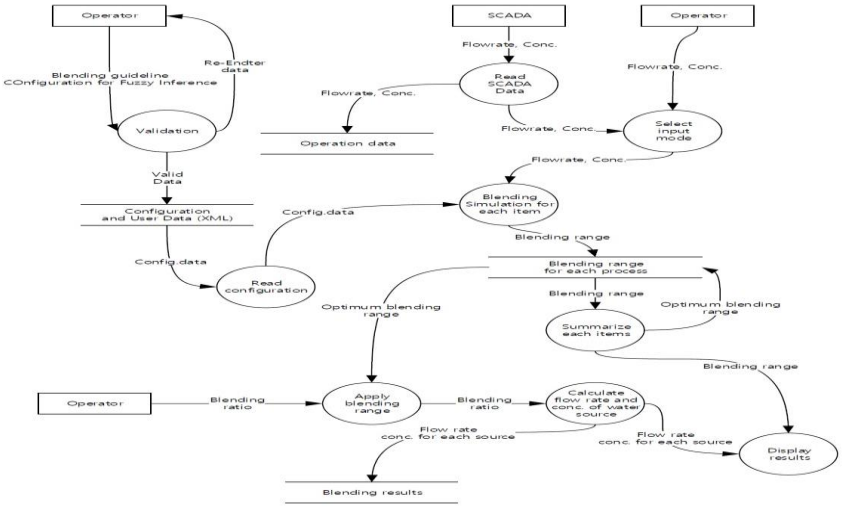

Fig. 1. Data Flow Diagram of process operation for optimum blending value of WTP

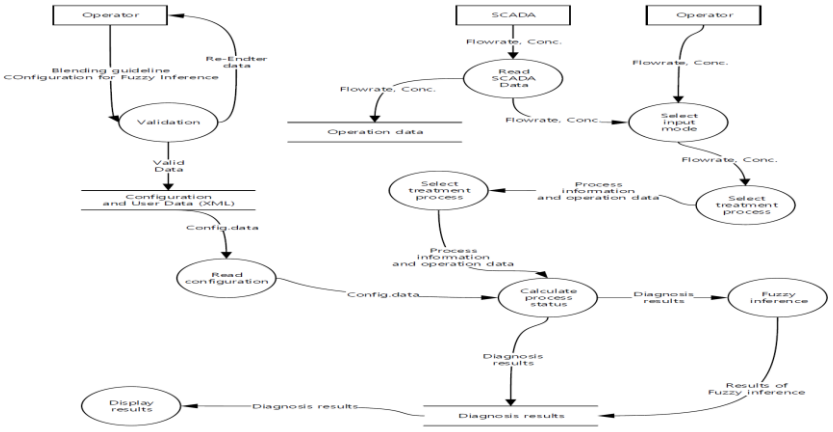

Fig.2. Data Flow Diagram of process diagnosis for WTP

In Figure 1, it measures input water quality concentration and it determines whether blending is necessary. Then, if the water quality is satisfied it goes through

coagulation tank for coagulant dose. After coagulation and sand filtration, it determines whether backwashing is needed by checking quantity of sand filtered water. At the same time, it decided water quality for specific purposes of water use. Then it goes through ozone and activated carbon process. At the activated carbon process, it also measure water quantity then decide whether backwashing is needed or not. Then, it goes to chlorination process and finally distributes to consumers

3 Results and Discussions

DSS in our WTP evaluates water quantity with multiple water sources at the target water quality in the blending tank and gathers operating data during water treatment process. At the distribution tank it provides information of reservoir level for scheduling water treatment process. In this process, it estimates demand and supply and decide quantity of water for the targeted consumer.

3.1 Process operation

A database of the various entities contains information about input water qualities and quantities for blending multiple water resources. It performed the automatic communication with the water treatment plant SCADA system for faster and real-time decision making. It can optimize of water blending ratios by using fuzzy algorithm with historical and real time data. Figure 3 displays process operation with seawater and brackish water.

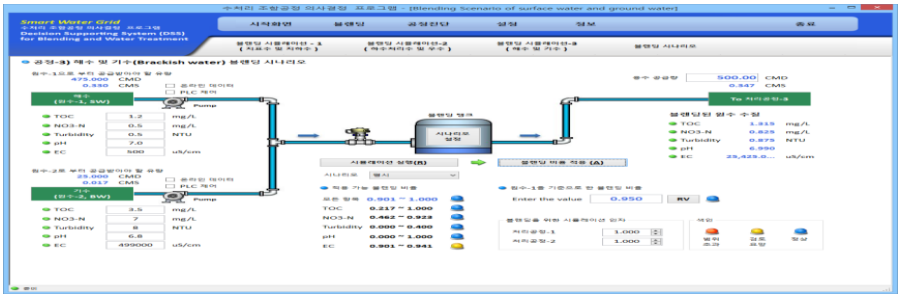

Fig. 3. Process operations with seawater and brackish water for WTP

3.2 Process diagnosis

Each component was defined to create an optimal water blending process in WTP. Depending upon the input water qualities and quantities, DSS support to help decision making and system diagnosis. Figure 4 exhibits process diagnosis using seawater and brackish water.

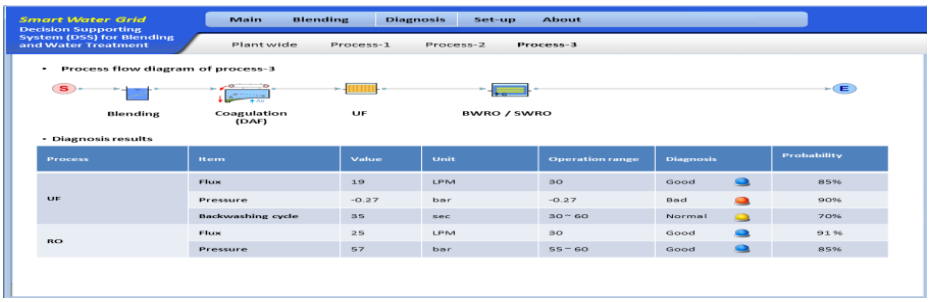

Fig. 4. Process diagnosis with seawater and brackish water for WTP

3.3 Outputs and applications

DDS consists of a user interface, analysis module, report module, database module and the gateway DSS. It is developed by MS Visual Studio C # working on the latest Windows OS. The user chart, table, a button and text are provided for the results of the analysis and the function of transmitting the control command to the user. The report module provides a variety of functions for displaying the analysis results and the analysis module works as decision making using fuzzy algorithm and mathematical model. Gateway performs a real-time communication with HMI and database module provides the ability to query large amounts of data, such as historical data.

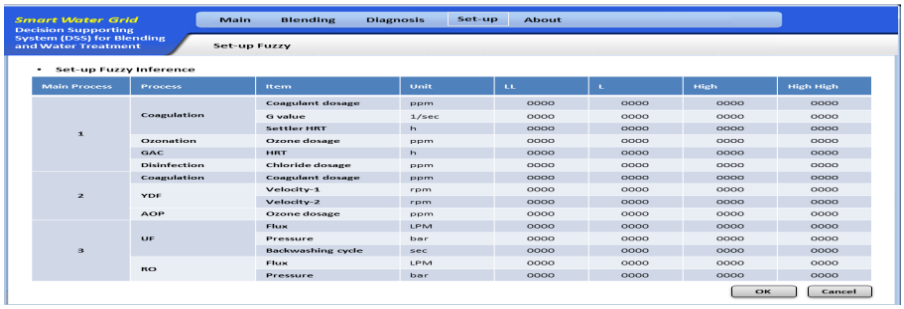

Fig. 5. Process set-up for WTP

4 Conclusion

The decision support system described in the paper is intended to support the operator to make informed decisions about the best course of action in water treatment system using multiple water resources. With DSS, the operator can organize calculated and analyzed data and expect long term operational and analytical results to apply for economic, social and environmental effects in the future.

Acknowledgments. This research was supported by a grant (KW-14-SWG) from the Smart Water Grid funded by the Ministry of Land, Transport and Maritime Affairs of the Korea Government.

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